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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

16 DEC 2004

Applicant's or agent's file reference FP18004	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. PCT/AU2003/000770	International Filing Date *(day/month/year)* 20 June 2003	Priority Date *(day/month/year)* 20 June 2002

International Patent Classification (IPC) or national classification and IPC

Int. Cl. [7] G01V 3/38, 1/26

Applicant

WMC RESOURCES LTD et al

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   [X] This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 6 sheet(s).

3. This report contains indications relating to the following items:

   - I [X] Basis of the report
   - II [ ] Priority
   - III [ ] Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV [ ] Lack of unity of invention
   - V [X] Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI [ ] Certain documents cited
   - VII [ ] Certain defects in the international application
   - VIII [ ] Certain observations on the international application

Date of submission of the demand	Date of completion of the report
7 January 2004	2 November 2004
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **S. T. PRING** Telephone No. (02) 6283 2210

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/AU2003/000770

I. Basis of the report

1. With regard to the elements of the international application:*

☐ the international application as originally filed.

☒ the description, pages **1,3-5,8-26,** as originally filed,
pages , filed with the demand,
pages **2,6,7,** received on **17 September 2004** with the letter of **17 September 2004**

☒ the claims, pages **28-31,33-35** as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages **27,32,36,** received on **17 September 2004** with the letter of **17 September 2004**

☒ the drawings, pages **1/7-7/7,** as originally filed,
pages , filed with the demand,
pages , received on with the letter of

☐ the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , received on with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/fig.

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-62	YES
	Claims		NO
Inventive step (IS)	Claims	1-62	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-62	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Novelty and inventive Step

EP 967 494 discloses a seismic data collection method with the use of GPS time stamps on both the energy signal source and data collected as well as cycling both energy source and GPS systems to maintain a standard. This results in a continuous data stream making it ideal for data storage.

WO 2002/073237 discloses a method of data processing seismic signals to improve spatial revolution by using spatially separated and time adjusted signals from a plurality of sensors to produce an output signal of smaller interval.

Neither of these citations disclose the taking of samples required and calculating the spatial derivative of adjacent samples data, thus reducing the noise ratio. Therefore the claims can be said to be both novel and to have an inventive step.

at least one data acquisition unit connectable to a plurality of sensors and being arranged, during use, to simultaneously gather geophysical data from the sensors, the or each data acquisition unit comprising time referencing means arranged to generate time reference data usable to control the time at which samples of geophysical data are taken; and

means for calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit so as to provide processed geophysical data with less noise.

Preferably, the time referencing means includes a GPS receiver. Alternatively or in addition, the time referencing means may include an accurate oscillator, preferably a precision oven controlled crystal oscillator, and a counter arranged to count signals generated by the oscillator.

In embodiments which include an oscillator, the data acquisition unit is preferably arranged to receive synchronisation signals useable by the processing means to adjust the frequency of the oscillator and adjust the times at which samples of geophysical data are taken so that the times at which samples of geophysical data are taken are synchronised with the times at which samples of geophysical data are taken in other data acquisition units.

Preferably, the data acquisition unit is arranged to receive programs and to store the programs in the data storage means for subsequent execution by the processing means.

Preferably, the data acquisition unit is arranged to calculate an average sample value for a plurality of corresponding repeat sample values when a plurality of data gathering operations are carried out as part of a geophysical survey so as to reduce the effect of interference on the samples and reduce the quantity of data. The data acquisition unit may be arranged to compare repeat samples and to discard samples which differ by a predetermined amount from the majority of the repeat samples.

Preferably, the data acquisition unit is arranged to calculate an average sample value for a plurality of consecutive samples taken during a data gathering operation carried out as

for a variation in magnitude of the transmitter current caused by a variation in power supplied to transmitter.

Preferably, the system also includes an energy source control unit connectable to the energy source and arranged to gather output data from the energy source, the energy source control unit including:

time referencing means arranged to generate time reference data usable to control the time at which gathering of the energy source output data occurs and to associate the energy source output data with the time reference data; and

data storage means for storing the energy source output data.

Preferably, the energy source control unit is a transmitter control unit arranged to control a transmitter so as to energise a transmitter loop in accordance with a predetermined frequency.

Preferably, the energy source control unit includes the same components as the data acquisition unit so that the transmitter control unit is capable of carrying out the functions of the data acquisition unit and vice versa.

Preferably, the system is arranged to correct for variations in magnitude of the transmitter current during a geophysical survey. The system may be arranged to correct for a variation in magnitude of the transmitter current caused by a reduction in power supplied to the transmitter.

In accordance with a second aspect of the present invention, there is provided a method of acquiring geophysical data, said method including the steps of:

providing at least one data acquisition unit arranged to simultaneously gather geophysical data from a plurality of sensors connected in use to the at least one data acquisition unit;

connecting at least one geophysical sensor to the at least one data acquisition unit;

generating at the data acquisition unit time reference data usable to control the

time at which gathering of samples of geophysical data are taken; and

calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit so as to produce processed geophysical data with less noise.

Preferably, the method further comprises the steps of:

providing at least one reference data acquisition unit arranged, during use, to gather geophysical data from the at least one reference sensor;

connecting each reference data acquisition unit to at least one reference sensor ;

calculating first spatial derivatives between at least some of the sensors connected to the data acquisition units and a reference sensor connected to the reference data acquisition unit during a first data gathering operation when the sensors are disposed in a first location;

calculating second spatial derivatives between at least some of the sensors connected to the data acquisition units and a reference sensor connected to the reference data acquisition unit during a second data gathering operation when the sensors are disposed in a second location; and

calculating a difference spatial derivative between the first and second spatial derivatives, each said difference spatial derivative being indicative of a spatial derivative between a sensor disposed in a first location and a sensor disposed in a second location.

Preferably, the method further comprises means for calculating an integral of the spatial derivatives so as to produce conventional geophysical data with less noise.

Preferably, the method further includes the step of correcting variations in the energy source using the reference data acquisition unit and associated reference sensor.

Preferably, the time referencing means includes a GPS receiver. Alternatively or in addition, the time referencing means may include an oscillator, preferably , a precision oven controlled crystal oscillator, and a counter arranged to count signals generated by oscillator.

Claims

1. A data acquisition system for gathering geophysical data, said system comprising:

at least one data acquisition unit connectable to a plurality of sensors and being arranged, during use, to simultaneously gather geophysical data from the sensors, the or each data acquisition unit comprising time referencing means arranged to generate time reference data usable to control the time at which samples of geophysical data are taken; and

means for calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit.

2. A data acquisition system as claimed in claim 1, wherein the time referencing means comprises a GPS receiver.

3. A data acquisition system as claimed in claim 1 or claim 2, wherein the time referencing means comprises an accurate oscillator.

4. A data acquisition system as claimed in claim 3, wherein the accurate oscillator comprises a precision oven controlled crystal oscillator, and the time referencing means further comprises a counter arranged to count signals generated by the oscillator.

5. A data acquisition system as claimed in claim 3 or claim 4, wherein the data acquisition unit is arranged to receive synchronisation signals useable to adjust the frequency of the oscillator and thereby adjust the times at which samples of geophysical data are taken so that the times at which samples of geophysical data are taken are synchronised with the times at which samples of geophysical data are taken in other data acquisition units.

6. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to receive and store programs for subsequent execution.

includes a transmitter and a transmitter loop.

35. A data acquisition system as claimed in claim 30 to 34, further comprising an energy source control unit connectable to the energy source and arranged to gather output data from the energy source, the energy source control unit comprising time referencing means arranged to generate time reference data usable to control the time at which samples of the energy source output data are taken and to associate the energy source output data with the time reference data.

36. A data acquisition system as claimed in claim 35, wherein the energy source control unit is a transmitter control unit arranged to control a transmitter so as to energise a transmitter loop in accordance with a predetermined frequency.

37. A data acquisition system as claimed in claim 35 or claim 36, wherein the energy source control unit includes the same components as the data acquisition unit so that the transmitter control unit is capable of carrying out the functions of the data acquisition unit and vice versa.

38. A method of acquiring geophysical data, said method including the steps of:

providing at least one data acquisition unit arranged to simultaneously gather geophysical data from a plurality of sensors connected in use to the at least one data acquisition unit;

connecting a plurality of sensors to the at least one data acquisition unit;

generating at the data acquisition unit time reference data usable to control the time at which gathering of samples of geophysical data are taken; and

calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit.

39. A method of acquiring geophysical data as claimed in claim 38, further comprising the steps of:

providing at least one reference data acquisition unit arranged, during use, to gather geophysical data from the at least one reference sensor;

60. A method as claimed in any one of claims 38 to 59, further comprising the step of providing each data acquisition unit with display means for providing information indicative of operation of the data acquisition unit to an operator.

61. A system as claimed in claim 33, wherein the system is arranged to correct variations in the energy source using the reference data acquisition unit and associated reference sensor.

62. A method as claimed in claim 53, further comprising the step of correcting variations in the energy source using the reference data acquisition unit and associated reference sensor.

ANNEXES TO THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

at least one data acquisition unit connectable to a plurality of sensors and being arranged, during use, to simultaneously gather geophysical data from the sensors, the or each data acquisition unit comprising time referencing means arranged to generate time reference data usable to control the time at which samples of geophysical data are taken; and

means for calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit so as to provide processed geophysical data with less noise.

Preferably, the time referencing means includes a GPS receiver. Alternatively or in addition, the time referencing means may include an accurate oscillator, preferably a precision oven controlled crystal oscillator, and a counter arranged to count signals generated by the oscillator.

In embodiments which include an oscillator, the data acquisition unit is preferably arranged to receive synchronisation signals useable by the processing means to adjust the frequency of the oscillator and adjust the times at which samples of geophysical data are taken so that the times at which samples of geophysical data are taken are synchronised with the times at which samples of geophysical data are taken in other data acquisition units.

Preferably, the data acquisition unit is arranged to receive programs and to store the programs in the data storage means for subsequent execution by the processing means.

Preferably, the data acquisition unit is arranged to calculate an average sample value for a plurality of corresponding repeat sample values when a plurality of data gathering operations are carried out as part of a geophysical survey so as to reduce the effect of interference on the samples and reduce the quantity of data. The data acquisition unit may be arranged to compare repeat samples and to discard samples which differ by a predetermined amount from the majority of the repeat samples.

Preferably, the data acquisition unit is arranged to calculate an average sample value for a plurality of consecutive samples taken during a data gathering operation carried out as

for a variation in magnitude of the transmitter current caused by a variation in power supplied to transmitter.

Preferably, the system also includes an energy source control unit connectable to the energy source and arranged to gather output data from the energy source, the energy source control unit including:

time referencing means arranged to generate time reference data usable to control the time at which gathering of the energy source output data occurs and to associate the energy source output data with the time reference data; and

data storage means for storing the energy source output data.

Preferably, the energy source control unit is a transmitter control unit arranged to control a transmitter so as to energise a transmitter loop in accordance with a predetermined frequency.

Preferably, the energy source control unit includes the same components as the data acquisition unit so that the transmitter control unit is capable of carrying out the functions of the data acquisition unit and vice versa.

Preferably, the system is arranged to correct for variations in magnitude of the transmitter current during a geophysical survey. The system may be arranged to correct for a variation in magnitude of the transmitter current caused by a reduction in power supplied to the transmitter.

In accordance with a second aspect of the present invention, there is provided a method of acquiring geophysical data, said method including the steps of:

providing at least one data acquisition unit arranged to simultaneously gather geophysical data from a plurality of sensors connected in use to the at least one data acquisition unit;

connecting at least one geophysical sensor to the at least one data acquisition unit;

generating at the data acquisition unit time reference data usable to control the

time at which gathering of samples of geophysical data are taken; and

calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit so as to produce processed geophysical data with less noise.

Preferably, the method further comprises the steps of:

providing at least one reference data acquisition unit arranged, during use, to gather geophysical data from the at least one reference sensor;

connecting each reference data acquisition unit to at least one reference sensor ;

calculating first spatial derivatives between at least some of the sensors connected to the data acquisition units and a reference sensor connected to the reference data acquisition unit during a first data gathering operation when the sensors are disposed in a first location;

calculating second spatial derivatives between at least some of the sensors connected to the data acquisition units and a reference sensor connected to the reference data acquisition unit during a second data gathering operation when the sensors are disposed in a second location; and

calculating a difference spatial derivative between the first and second spatial derivatives, each said difference spatial derivative being indicative of a spatial derivative between a sensor disposed in a first location and a sensor disposed in a second location.

Preferably, the method further comprises means for calculating an integral of the spatial derivatives so as to produce conventional geophysical data with less noise.

Preferably, the method further includes the step of correcting variations in the energy source using the reference data acquisition unit and associated reference sensor.

Preferably, the time referencing means includes a GPS receiver. Alternatively or in addition, the time referencing means may include an oscillator, preferably , a precision oven controlled crystal oscillator, and a counter arranged to count signals generated by oscillator.

Claims

1. A data acquisition system for gathering geophysical data, said system comprising:

at least one data acquisition unit connectable to a plurality of sensors and being arranged, during use, to simultaneously gather geophysical data from the sensors, the or each data acquisition unit comprising time referencing means arranged to generate time reference data usable to control the time at which samples of geophysical data are taken; and

means for calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit.

2. A data acquisition system as claimed in claim 1, wherein the time referencing means comprises a GPS receiver.

3. A data acquisition system as claimed in claim 1 or claim 2, wherein the time referencing means comprises an accurate oscillator.

4. A data acquisition system as claimed in claim 3, wherein the accurate oscillator comprises a precision oven controlled crystal oscillator, and the time referencing means further comprises a counter arranged to count signals generated by the oscillator.

5. A data acquisition system as claimed in claim 3 or claim 4, wherein the data acquisition unit is arranged to receive synchronisation signals useable to adjust the frequency of the oscillator and thereby adjust the times at which samples of geophysical data are taken so that the times at which samples of geophysical data are taken are synchronised with the times at which samples of geophysical data are taken in other data acquisition units.

6. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to receive and store programs for subsequent execution.

includes a transmitter and a transmitter loop.

35. A data acquisition system as claimed in claim 30 to 34, further comprising an energy source control unit connectable to the energy source and arranged to gather output data from the energy source, the energy source control unit comprising time referencing means arranged to generate time reference data usable to control the time at which samples of the energy source output data are taken and to associate the energy source output data with the time reference data.

36. A data acquisition system as claimed in claim 35, wherein the energy source control unit is a transmitter control unit arranged to control a transmitter so as to energise a transmitter loop in accordance with a predetermined frequency.

37. A data acquisition system as claimed in claim 35 or claim 36, wherein the energy source control unit includes the same components as the data acquisition unit so that the transmitter control unit is capable of carrying out the functions of the data acquisition unit and vice versa.

38. A method of acquiring geophysical data, said method including the steps of:

providing at least one data acquisition unit arranged to simultaneously gather geophysical data from a plurality of sensors connected in use to the at least one data acquisition unit;

connecting a plurality of sensors to the at least one data acquisition unit;

generating at the data acquisition unit time reference data usable to control the time at which gathering of samples of geophysical data are taken; and

calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit.

39. A method of acquiring geophysical data as claimed in claim 38, further comprising the steps of:

providing at least one reference data acquisition unit arranged, during use, to gather geophysical data from the at least one reference sensor;

60. A method as claimed in any one of claims 38 to 59, further comprising the step of providing each data acquisition unit with display means for providing information indicative of operation of the data acquisition unit to an operator.

61. A system as claimed in claim 33, wherein the system is arranged to correct variations in the energy source using the reference data acquisition unit and associated reference sensor.

62. A method as claimed in claim 53, further comprising the step of correcting variations in the energy source using the reference data acquisition unit and associated reference sensor.